

STANDARDS DEVELOPMENT
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A WATER POLLUTION CONTROL STATUS REPORT

ACTIVE MINING OPERATIONS IN THE PROVINCE OF ONTARIO

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WATER POLLUTION CONTROL
STATUS REPORT

ACTIVE MINING OPERATIONS
IN THE
PROVINCE OF ONTARIO

JULY 1, 1978

STANDARDS DEVELOPMENT BRANCH
135 ST. CLAIR AVENUE WEST
TORONTO, ONTARIO M4V 1P5

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INTRODUCTION

This report is intended to:

- (1) provide an indication of the current level of environmental control (water only) at existing active mining operations in the Province of Ontario. Limited statistics concerning abandoned Ontario mining properties are also quoted when such statistics are relevant to the discussion.
- (2) identify specific instances within the Ontario mineral industry of noncompliance with published environmental guidelines of the Ontario Ministry of the Environment.
- (3) delineate outstanding or troublesome environmental control problems in the Ontario mineral industry and suggest procedures which would act to clarify, minimize or overcome such problems.

NOTE: Sand and gravel operations as well as limestone, dolomite and marble quarries are excluded from this report.

The effluent concentrations and/or loadings quoted in this publication are averages of available 1977 and 1978 data. All concentrations and/or loadings are quoted on a "gross" (as opposed to a "net") basis. In addition, all concentrations are expressed as parts per million (ppm) with the exception of pH which is expressed in standard pH units.

PROVINCE OF ONTARIO GENERAL DATA SUMMARY

- (1) Total Number of Producing Mines
53
- (2) Total Current Tailings Disposal Rate
100,243 tons/day
- (3) Total Tailings Deposited to Date in Currently Active Areas
741,252,000 tons
- (4) Total Tailings Contained in Existing Abandoned Tailings Basins
336,100,000 tons
- (5) Total Tailings Currently "On Ground" in Ontario
1,077,352,000 tons
- (6) Total Area of all Active Tailings Basins
17,073 acres
- (7) Total Area of all Abandoned Tailings Basins
7,694 acres
- (8) Total Area of all Active and Abandoned Tailings Basins
24,767 acres
(38.7 square miles)
- (9) Total Area of all Active and Abandoned Tailings Basins
Currently Revegetated (by nature and/or by man)

1,200 acres
(1.9 square miles)
- (10) Total Volume of Wastewater Recycled from Tailings Areas
for Re-use in Mineral Processing Operations

111,578,800 imperial gallons per day

(11) Total Volume Wastewater Discharged from Active Tailings Areas to Provincial Watercourses

82,550,000 imperial gallons/day.

TOTAL PROVINCIAL LOADINGS (lbs/day)

| | |
|------------------|--------|
| Suspended Solids | 13,773 |
| Copper | 290 |
| Nickel | 453 |
| Lead | 33 |
| Zinc | 183 |
| Arsenic | 77 |

NOTE: The total loadings quoted here for suspended solids, copper, nickel, lead and zinc are MAXIMUM values. On the other hand, the total loading quoted for arsenic is a MINIMUM value. In reality, total Provincial arsenic loadings from active tailings areas probably approach 100 lbs/day.

PROVINCIAL NONCOMPLIANCE SITUATIONS

| | <u>Provincial Guideline Maximum Permitted Concentration or Range</u> | <u>Number of Instances of Noncompliance</u> |
|------------------|----------------------------------------------------------------------------------|-----------------------------------------------------|
| pH | 5.5 to 10.6 | none |
| Suspended Solids | 15 ppm | 12* |
| Copper | 1 ppm | 1 |
| Nickel | 1 ppm | 3 |
| Lead | 1 ppm | none |

| | <u>Provincial Guideline</u> | <u>Number of Instances of Noncompliance</u> |
|-------------|-------------------------------------------------|---------------------------------------------|
| | <u>Maximum Permitted Concentration or Range</u> | |
| Zinc | 1 ppm | 2 |
| Cu+Ni+Pb+Zn | 1 ppm | 8** |
| Arsenic | .5 ppm | 5 |

* plus three instances of near noncompliance

** plus five instances of near noncompliance

IMPORTANT NOTE:

While, as indicated above, there are 31 instances of noncompliance in the Province, this does not mean that 31 mining operations are in noncompliance. For instance, if a particular operation is in noncompliance with copper, nickel, lead or zinc, it is automatically in noncompliance with the cumulative (Cu+Ni+Pb+Zn) metal guideline. Similarly, non-compliance with the suspended solids guideline quite often gives rise to noncompliance with one of the metal guidelines due to the metal content of the suspended solids themselves.

In reality, a total of approximately 20 mining operations are in noncompliance for one reason or another. Of this total, 6 are essentially in noncompliance for suspended solids alone.

EFFLUENT CONCENTRATIONS AND WASTE LOADINGS FOR SPECIFIC ONTARIO MINING OPERATIONS

See Appendix A beginning on page 11.

ESTIMATION OF DECANT WATER RECYCLED IN ONTARIO

See Appendix B on page 74.

OUTSTANDING ENVIRONMENTAL PROBLEMS IN THE ONTARIO MINERAL INDUSTRY

(A) Suspended Solids

As stated in "Guidelines for Environmental Control in the Ontario Mineral Industry - May 1, 1978"

"Unless otherwise indicated by the Ontario Ministry of the Environment, a mine-mill effluent should not contain more than 15 mg/litre of suspended solids".

The above guideline for suspended solids has been used by the Ontario government for approximately twenty years. With few exceptions, this guideline has been easily achieved using routine but well-engineered settling basins. Nevertheless, there are presently between 12 and 15 cases of noncompliance (suspended solids) in the Province. In many instances there is a definite relationship between suspended solids concentrations and contaminant (heavy metals, residual reagents etc.) carry-over. This fact coupled with the knowledge that practicable technology is available suggests that a maximum effort should be made to resolve all cases of suspended solids noncompliance in the Province. It is suggested that the resolution of suspended solids non-compliance situations is a priority item.

(B) CYANIDES (and related problems in the gold industry)

"Unless otherwise indicated by the Ontario Ministry of the Environment, a mine-mill effluent should not contain more than 2 mg/litre of cyanide (free and/or complexed) expressed as HCN. This is an interim guideline. As the availability of practicable technology permits, cyanide discharges should be reduced to the lowest levels attainable."

The above guideline, published in "Guidelines for Environmental Control in the Ontario Mineral Industry - May 1, 1978", will come into effect on May 1, 1979.

Serious cyanide problems in the Ontario mineral industry are currently restricted to active gold mine/mill operations. The eight mines now in production generate a daily total of 11,400 tons of ore. This ore is treated with 11,125 lbs. of sodium and/or calcium cyanide. Cyanide losses to provincial waterways approximate 5.39 per cent of total usage. Present total daily cyanide losses are in the order of 600 lbs.

Typical "total" cyanides reported in effluents from active Ontario gold operations range from .01 mg/litre to 12.7 mg/litre (1977 data). At least three operations in Ontario report final effluents containing cyanides in

excess of 2 mg/litre.

To complicate matters, some gold mill effluents contain abnormal quantities of arsenic and most contain undesirable concentrations of heavy metals (notably copper, zinc and nickel). These metals usually occur as metal-cyanide complexes. Some of these complexes are very stable.

In common with the uranium industry, hydrometallurgical difficulties in the gold industry have, to date, precluded the re-use, in gold mine/mill circuits, of wastewater from tailings area decants.

At least two active gold operations lack well defined, properly engineered tailings areas. In addition, mercury is used at some of the gold properties in the Province.

Although accounting for only 11.4 per cent of the total ore milled daily in the Province, the gold industry is responsible for virtually 100 per cent of all cyanide discharged by active Ontario mine/mill operations, 16 per cent of the suspended solids, 18 per cent of the nickel, 23 per cent of the zinc, 76 per cent of the copper and 98 per cent of the arsenic.

The above data indicates that the resolution of environmental problems in Ontario gold camps should be a priority item.

Additional comments are as follows:

- (1) Complete control facilities for suspended solids, heavy metals and cyanides should be required at all new or significantly expanded gold operations in the Province. Such facilities should be in place before milling commences.
- (2) Staged programs for the control of suspended solids, heavy metals and cyanides (when and where required) should be negotiated for all existing gold operations in the Province. The destruction of cyanide by means such as alkaline chlorination is recommended.
- (3) A degree of natural waste treatment can be achieved by ponding high-strength waste cyanide solutions (example: barren solution) in contact with the atmosphere. The effectiveness of this type of treatment appears to be seasonal in nature with maximum cyanide breakdown occurring in the warm summer months and minimum breakdown occurring during the cold winter months.

Barren retention ponds are becoming quite common. Because they contain such toxic wastes, all existing barren retention ponds should be constantly monitored for physical stability, contaminated seepage flows and the possibility of groundwater contamination.

In addition, all such ponds should be surrounded by adequate fencing where this is practicable.

The contents of the ponds should be identified by large, highly visible signs placed in the immediate vicinity of the ponds.

(C) Phenols

Very little is known about the phenolic content of Ontario mine/mill wastewaters. It is therefore recommended that all mine/mill wastewaters in the Province be sampled for phenols in the near future. Particular emphasis should be placed on the effluents from operations employing froth flotation.

An Ontario mine/mill effluent guideline of 20 ppb for phenols will be introduced in the fall of 1978.

(D) Ammonia

Quoting from "Guidelines for Environmental Control in the Ontario Mineral Industry - May 1, 1978"

"Unless otherwise specified by the Ontario Ministry of the Environment, the concentration of ammonia (NH_3 expressed as N) in water at a designated control point should not exceed 10 mg/litre.

In view of the known acute toxicity of ammonia to aquatic life, a more stringent effluent quality requirement may be applied consistent with the availability of practicable technology.

NOTE: With regard to the above guideline and in recognition of the safety aspects of ANFO explosives that find general use, minewater will be considered on a special basis. However, good housekeeping practices in the mine must be maximized and available waste treatment technology must be utilized to meet the guidelines when and where practicable".

Ammonia (NH_3 as N) levels in Ontario mine/mill effluents are routinely below 10 mg/litre and are quite commonly below 2 mg/litre. However, there are a small number of properties (approximately 6) in the Province that still use ammonia as a reagent in ore processing or for one reason or another give rise to minewater discharges that contain undesirable amounts of ammonia.

Where practicable, control programs to resolve these problems should be negotiated.

A P P E N D I X A

EFFLUENT CONCENTRATIONS AND WASTE LOADINGS

FOR SPECIFIC ONTARIO MINING OPERATIONS

PRECIOUS METAL MINING OPERATIONS

GOLD

SILVER

NAME: Agnico-Eagle Mines Ltd.

LOCATION: Cobalt

PRODUCTS: Silver, Cobalt concentrates

RATED CAPACITY OF MILL: 450 - 500 tons per day

TAILINGS DISCHARGED: 30,000 tons per year

VOLUME FINAL EFFLUENT: 70,000 Igpd (est.)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.9 | 45 | 0.02 | <0.02 | <0.01 | <0.02 | <0.07 | 0.90 |

| | | | | | | | |
|-----------------------|------|------|-------|-------|-------|------|------|
| Loadings (lbs/day) | 31.5 | 0.01 | <0.01 | <0.01 | <0.01 | 0.06 | 0.63 |
|-----------------------|------|------|-------|-------|-------|------|------|

RECEIVING WATERCOURSE: Glen Lake/Giroux Lake

NAME: Canadaka Mines Ltd.

LOCATION: Cobalt, Township of Coleman

PRODUCTS: Silver concentrate; Flotation & Gravity

RATED CAPACITY OF MILL: 400 tons per day

TAILINGS DISCHARGED: 137,000 tons per year

VOLUME FINAL EFFLUENT: 73,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 8.2 | 28 | <0.04 | <0.07 | <0.03 | 0.04 | <0.18 | 0.61 |

| | | | | | | | |
|-----------------------|----|-------|-------|-------|------|-------|------|
| Loadings (lbs/day) | 20 | <0.03 | <0.05 | <0.02 | 0.03 | <0.13 | 0.45 |
|-----------------------|----|-------|-------|-------|------|-------|------|

RECEIVING WATERCOURSE: Giroux Lake

NAME: Teck Corporation Ltd.
Silverfields Mining Division

LOCATION: Cobalt - 2½ miles SE of Cobalt
Township of Coleman

PRODUCTS: Silver concentrates; Gravity & Flotation

RATED CAPACITY OF MILL: 240 tons per day

TAILINGS DISCHARGED: 74,000 tons per year (estimated)

VOLUME FINAL EFFLUENT: 216,000 Igpd (estimated)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.8 | 25.5 | 0.03 | <0.02 | <0.01 | <0.01 | <0.07 | 0.53 |

| | | | | | | |
|--------------------------|------|-------|-------|-------|-------|------|
| Loadings (lbs/day) 55 | 0.06 | <0.04 | <0.02 | <0.02 | <0.15 | 1.14 |
|--------------------------|------|-------|-------|-------|-------|------|

RECEIVING WATERCOURSE: Cart Lake

NOTE: Mine water (50,000 Igpd) is discharged to Giroux Lake.
Chemical characteristics not available.

NAME: Pamour Porcupine Mines Ltd.
Schumacher Division

LOCATION: Timmins area - Whitney & Tisdale twps.

PRODUCTS: Gold, Silver, Copper

RATED CAPACITY OF MILL: 3,000 tons per day - gold: copper ore

TAILINGS DISCHARGED: 960,000 tons per year

VOLUME FINAL EFFLUENT: 1,600,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

(Tailings Discharge Point)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.7 | 2.1 | 9.5 | 0.11 | <0.01 | 0.09 | <9.71 | |

| | | | | | | |
|-----------------------|----|-----|------|-------|------|---------|
| Loadings (lbs/day) | 34 | 152 | 1.76 | <0.16 | 1.44 | <155.36 |
|-----------------------|----|-----|------|-------|------|---------|

RECEIVING WATERCOURSE: Porcupine River

NOTE: At downstream sample point in discharge stream:

| <u>pH</u> | <u>SS</u> | <u>Cu</u> |
|-----------|-----------|-----------|
| 7.5 | 5.8 | .008 |

NAME: Pamour Porcupine Mines Ltd.
Pamour Mill

LOCATION: Timmins area

PRODUCTS: Gold

RATED CAPACITY OF MILL: 3,000 tons per day

TAILINGS DISCHARGED: 1,000,000 tons per year

VOLUME FINAL EFFLUENT: 800,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

Tailings Discharge Point

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.5 | 1.5 | 0.06 | 0.04 | <0.01 | 0.07 | <0.18 | |

| | | | | | | |
|-----------------------|----|------|------|-------|------|-------|
| Loadings (lbs/day) | 12 | 0.48 | 0.32 | <0.08 | 0.56 | <1.44 |
|-----------------------|----|------|------|-------|------|-------|

RECEIVING WATERCOURSE: Porcupine River

NOTE: At downstream sample point in discharge stream:

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Zn</u> |
|-----------|-----------|-----------|-----------|
| 7.5 | 1.3 | .01 | .03 |

NAME: Pamour Porcupine Mines Ltd.
Ross Mine

LOCATION: Timmins area, 11 miles SE of Matheson

PRODUCTS: Gold ore

RATED CAPACITY OF MILL: (Closed June 1977): 450 tons per day

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: Mine water: 252,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.7 | 10.8 | 0.04 | 0.41 | <0.10* | 0.05 | <0.60 | |

| | | | | | | |
|-----------------------|------|------|------|-------|------|-------|
| Loadings (lbs/day) | 27.2 | 0.10 | 1.03 | <0.25 | 0.13 | <1.51 |
|-----------------------|------|------|------|-------|------|-------|

RECEIVING WATERCOURSE: Ross Creek/Black River

* Nov. 17, 1971, OWRC data.

NAME: Dome Mines Ltd.

LOCATION: 2 miles SW of South Porcupine, Timmins area

PRODUCTS: Gold, Silver

RATED CAPACITY OF MILL: 2,000 tons per day

TAILINGS DISCHARGED: 427,000 tons per year

VOLUME FINAL EFFLUENT: 1,678,330 Igpd (includes mine water)
(264,500 Igpd mine water)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.7 | 19 | .48 | .16 | .03 | .13 | .80 | .01 |

| | | | | | | | |
|-----------------------|-----|------|------|-----|------|-------|-----|
| Loadings (lbs/day) | 319 | 8.06 | 2.69 | .50 | 2.18 | 13.43 | .17 |
|-----------------------|-----|------|------|-----|------|-------|-----|

RECEIVING WATERCOURSE: Porcupine Creek/Porcupine Lake

NOTE: At this property, effluent concentrations minus influent concentrations (net values) give the following chemical characteristics of discharge:

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.7 | 8 | .36 | .11 | Nil | .06 | .53 | Nil |

NAME: Kerr Addison Mines Ltd.

LOCATION: Virginiatown, N. Ontario

PRODUCTS: Gold, Silver

RATED CAPACITY OF MILL: 1,400 tons per day

TAILINGS DISCHARGED: 150,000 tons per year

VOLUME FINAL EFFLUENT: 3,171,000 Igpd decant
1,000,000 Igpd mine water

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| | <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|---------------|-----------------------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| Decant | 9.0 | 5 | 0.91 | 1.28 | <0.01 | 0.71 | 2.91 | 0.29 |
| Mine water | 7.8 | 3 | 0.04 | 0.27 | <0.01 | 0.04 | <0.36 | 0.12 |
| | Loadings (lbs/day) | | | | | | | |
| Decant | | 159 | 28.7 | 40.6 | <0.3 | 22.5 | <92.3 | 9.2 |
| Mine water | | 30 | 0.4 | 2.7 | <0.1 | 0.4 | <3.6 | 1.2 |

RECEIVING WATERCOURSE: Larder Lake

NAME: Wilroy Mines Ltd.
Macassa Division

LOCATION: Kirkland Lake, N. Ontario

PRODUCTS: Gold

RATED CAPACITY OF MILL: 281 tons per day

TAILINGS DISCHARGED: 100,000 tons per year

VOLUME FINAL EFFLUENT: 159,000 Igpd (decant)
433,000 Igpd mine water (separate discharge)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| | pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-----------------------|-----|-----|------|-------|------|------|-------------|-------|
| Decant | 7.9 | 123 | 0.25 | 0.13 | 0.02 | 0.64 | 1.04 | <0.01 |
| Mine Water | 7.6 | 159 | 1.62 | <0.01 | 0.01 | 0.17 | <1.81 | <0.01 |
| Loadings (lbs/day) | | | | | | | | |
| Decant | | 196 | 0.40 | 0.21 | 0.03 | 1.02 | 1.65 | <0.02 |
| Mine Water | | 688 | 7.01 | <0.04 | 0.04 | 0.74 | <7.84 | <0.04 |

RECEIVING WATERCOURSE: Amikougam Creek

NAME: Dickenson Mines Ltd.

LOCATION: Balmertown

PRODUCTS: Gold, Silver

RATED CAPACITY OF MILL: 470 tons per day

TAILINGS DISCHARGED: 129,000 tons per year
(30% used as backfill)

VOLUME FINAL EFFLUENT: 7,200,000 Igpd (Est.)*
(at Balmer Creek Bridge)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.3 | 10 | 0.31 | 0.45 | 0.05 | 0.19 | 1.00 | 0.90 |

| | | | | | | | |
|-----------------------|-----|------|------|-----|------|----|------|
| Loadings (lbs/day) | 720 | 22.3 | 32.4 | 3.6 | 13.7 | 72 | 64.8 |
|-----------------------|-----|------|------|-----|------|----|------|

RECEIVING WATERCOURSE: Balmer Lake/Chukuni River

* Common discharge for Dickenson & Campbell Red Lake Mines

NAME: Campbell Red Lake Mines Ltd.

LOCATION: Balmertown

PRODUCTS: Gold

RATED CAPACITY OF MILL: 800 tons per day

TAILINGS DISCHARGED: 500,000 tons per year

VOLUME FINAL EFFLUENT: 7,200,000 Igpd (Est.)*

(at Balmer Creek Bridge)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-----|----|------|------|------|------|-------------|------|
| 7.3 | 10 | 0.31 | 0.45 | 0.05 | 0.19 | 1.00 | 0.90 |

Loadings
(lbs/day) See Dickenson Mines

RECEIVING WATERCOURSE: Balmer Lake/Chukuni River

* Common discharge for Campbell Red Lake & Dickenson Mines

SULPHIDE MINING OPERATIONS

COPPER

NICKEL

LEAD

ZINC

NAME: Falconbridge Nickel Mines Ltd.
Strathcona Mine/Mill Complex.

LOCATION: 30 miles north of Sudbury

PRODUCTS: Copper/Nickel concentrates

RATED CAPACITY OF MILL: 8,500 tons per day

TAILINGS DISCHARGED: 1,000,000 tons per year

VOLUME FINAL EFFLUENT: 4,000,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.0 | 3.1 | .03 | .52 | <0.1 | 0.05 | <.70 | |

| | | | | | | |
|-----------------------|-----|-----|------|------|-----|-----|
| Loadings (lbs/day) | 124 | 1.2 | 20.8 | <4.0 | 2.0 | <28 |
|-----------------------|-----|-----|------|------|-----|-----|

RECEIVING WATERCOURSE: Moose Lake/Moose Creek/Onaping River

NAME: Falconbridge Nickel Mines Ltd.
Falconbridge and East Mines

LOCATION: 9 miles NE of Sudbury

PRODUCTS: Nickel/Copper concentrate

RATED CAPACITY OF MILL: 3,000 tons per day

TAILINGS DISCHARGED: 200,000 tons per year

VOLUME FINAL EFFLUENT: 2,000,000 lpgd (inflow to Fault Lake)
1,629,000 lpgd (East Mine)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| | <u>PH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|------------|-----------------------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| Fault Lake | 7.2 | <15 | 0.16 | 1.6 | <0.10 | 0.06 | <1.92 | |
| East Mine | 7.1 | 2 | 0.03 | 0.88 | <0.10 | 0.06 | <1.07 | |
| | Loadings (lbs/day) | | | | | | | |
| Fault Lake | | <300 | 3.2 | 32 | <2 | 1.2 | <38.4 | |
| East Mine | | 32.6 | 0.49 | 14.34 | <1.63 | 0.98 | <17.43 | |

RECEIVING WATERCOURSE: Fault Lake/Wanapitei River
Mine water to Emery Creek/
Wanapitei River (No decant - seeps through
gravel aquifers into
Wanapitei Lake).

NAME: Falconbridge Copper Ltd.
(Sturgeon Lake Mines Ltd.)
Ignace

LOCATION: 5 miles E of Mattabi Mines Ltd.

PRODUCTS: Copper, Zinc, Lead concentrates

RATED CAPACITY OF MILL: 1,200 tons per day

TAILINGS DISCHARGED: 308,000 tons per year

VOLUME FINAL EFFLUENT: 604,800 Igpd (April 25/77 to October 17/77)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 10.2 | 64 | 0.08 | 0.04 | 0.27 | <0.79 | <1.18 | |

| | | | | | | |
|-----------------------|-----|------|------|------|-------|-------|
| Loadings (lbs/day) | 387 | 0.48 | 0.24 | 1.63 | <4.78 | <7.13 |
|-----------------------|-----|------|------|------|-------|-------|

RECEIVING WATERCOURSE: Lyon Lake/Sturgeon Lake

NAME: Selco Mining Corp. Ltd.
Ear Falls

LOCATION: Uchi Lake area, South Bay Mine

PRODUCTS: Copper, Zinc, Silver concentrates

RATED CAPACITY OF MILL: 500 tons per day

TAILINGS DISCHARGED: 132,000 tons per year

VOLUME FINAL EFFLUENT: 715,000 Igpd (Est.)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.8 | <15 | 0.05 | <0.01 | <0.03 | 0.84 | <.93 | |

Loadings
(lbs/day) <107 0.36 <0.07 <0.21 6.01 <6.65

RECEIVING WATERCOURSE: Confederation Lake

NAME: Noranda Mines Ltd.
Geco Mine

LOCATION: Manitouwadge

PRODUCTS: Copper, Zinc, Silver, Lead concentrates

RATED CAPACITY OF MILL: 5,000 tons per day

TAILINGS DISCHARGED: 1,000,000 tons per year

VOLUME FINAL EFFLUENT: 950,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-----|-----|------|----|-------|-----|-------------|----|
| 6.9 | 9.2 | 0.15 | - | <0.01 | 3.2 | <3.36 | |

Loadings
(lbs/day) 87 1.42 - <0.10 30.4 <31.92

RECEIVING WATERCOURSE: Mose Lake via ditch.

NAME: Union Miniere Explorations and Mining Corp. Ltd., Thierry Mine

LOCATION: 12 miles from Pickle Lake on Kapkichi Lake

PRODUCTS: Copper, Nickel concentrates

RATED CAPACITY OF MILL: 4,000 tons per day (actual milling 2,000 tpd.)

TAILINGS DISCHARGED: 730,000 tons per year

VOLUME FINAL EFFLUENT: 1,300,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------------------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.4 | 10.0 | 0.05 | 0.02 | 0.02 | 0.02 | 0.11 | <0.01 |
| Loadings (lbs/day) | 130 | 0.65 | 0.26 | 0.26 | 0.26 | 1.43 | <0.13 |

RECEIVING WATERCOURSE: Ponsford Lake

NAME: Mattabi Mines Ltd.
Ignace

LOCATION: 45 miles NE of Ignace

PRODUCTS: Zinc, Copper, Silver, Lead concentrates

RATED CAPACITY OF MILL: 3,000 tons per day

TAILINGS DISCHARGED: 841,975 tons per year (1977 rate)

VOLUME FINAL EFFLUENT: 1,783,000 gallons per day

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 8.0 | 6 | 0.03 | 0.02 | 0.06 | 1.60 | 1.71 | |

| | | | | | | |
|-----------------------|-----|------|------|------|-------|-------|
| Loadings (lbs/day) | 107 | 0.53 | 0.36 | 1.07 | 28.53 | 30.49 |
|-----------------------|-----|------|------|------|-------|-------|

RECEIVING WATERCOURSE: Bell River/Sturgeon Lake

NAME: Texasgulf Canada Ltd.
Timmins

LOCATION: 15 miles N of Timmins (minesite)
12 miles NE of Timmins (metallurgical site)

PRODUCTS: Zinc, Copper, Silver, Cadmium, Tin concentrates

RATED CAPACITY OF MILL: 9,000 tons per day - design rate
10,000 tons per day - production rate

TAILINGS DISCHARGED: 3,000,000 tons per year

VOLUME FINAL EFFLUENT: 6,100,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-----|----|------|-------|------|-----|-------------|----|
| 6.7 | 4 | <0.1 | <0.01 | <0.1 | 0.4 | <.61 | |

| | | | | | | |
|-----------------------|-----|------|------|------|------|--------|
| Loadings (lbs/day) | 244 | <6.1 | <.61 | <6.1 | 24.4 | <37.21 |
|-----------------------|-----|------|------|------|------|--------|

RECEIVING WATERCOURSE: Porcupine River

NOTE: The minesite drains into the Mattagami River watershed via Kidd Creek.

The metallurgical site (see above) drains into the Porcupine River.

NAME: INCO Metals Company
Shebandowan

LOCATION: Lower Shebandowan Lake, west of Thunder Bay

PRODUCTS: Nickel, Copper, Cobalt concentrates

RATED CAPACITY OF MILL: 2,000 tons per day

TAILINGS DISCHARGED: 250,000 tons per year

VOLUME FINAL EFFLUENT: 840,000 l gpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.5 | 3 | <0.003 | 0.050 | <0.002 | <0.008 | <0.063 | |

| | | | | | | |
|-----------------------|----|-------|------|-------|-------|-------|
| Loadings (lbs/day) | 25 | <0.03 | 0.42 | <0.02 | <0.07 | <0.53 |
|-----------------------|----|-------|------|-------|-------|-------|

RECEIVING WATERCOURSE: Gold Creek

NAME: INCO Metals Company
Copper Cliff North Mine

LOCATION: Sudbury

PRODUCTS: Copper/Nickel Ore (to Clarabelle Mill)

RATED CAPACITY OF MILL: * 7,000 tons per day

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 500,000 Igpd (minewater)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|

To Copper Cliff concentrator & smelter.

Loadings
(lbs/day) N/A

RECEIVING WATERCOURSE: P - Q Tailings Area

* Shut down early 1978.

NAME: INCO Metals Company
Copper Cliff South Mine

LOCATION: Sudbury

PRODUCTS: Copper/Nickel Ore (to Clarabelle Mill)

RATED CAPACITY OF MILL: 3,500 tons per day

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 1,464,000 Igpd (minewater)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|

To M - Tailings area

Loadings
(lbs/day) N/A

RECEIVING WATERCOURSE: Junction Creek via
Copper Cliff treatment plant.

NAME: INCO Metals Company
Clarabelle Mine/Mill

LOCATION: West Sudbury

PRODUCTS: Bulk concentrates of copper/nickel
and rougher pyrrhotite conc.

RATED CAPACITY OF MILL: 35,000 tons per day

TAILINGS DISCHARGED: 6,334,734 tons per year (17,400 tpd)

VOLUME FINAL EFFLUENT: 10,691,000 l/gpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|

Discharged to tailings area

Loadings
(lbs/day)

Not applicable

RECEIVING WATERCOURSE: P-Q tailings area/Copper Cliff Creek.

NAME: INCO Metals Company
Coleman Mine

LOCATION: 2.5 miles NE of Levack Mine (Sudbury)

PRODUCTS: Nickel ore (to Clarabelle mill)

RATED CAPACITY OF MILL: 3,700 tons per day

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 171,000 Igpd (minewater)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 11.4 | 15 | 0.1 | 0.4 | <0.002 | <.1 | <0.602 | |

Loadings
(lbs/day) 26 0.2 0.7 (neg.) <0.2 <1.03

RECEIVING WATERCOURSE: Moose Creek/Onaping River

NAME: INCO Metals Company
Crean Hill Mine*

LOCATION: 23 miles west of Sudbury

PRODUCTS: Nickel ore (to Clarabelle mill)

RATED CAPACITY OF MILL: 4,500 tons per day

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 565,000 Igpd (minewater)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-----|----|-----|-----|--------|------|-------------|----|
| 9.9 | 2 | 0.1 | 0.2 | <0.002 | <0.1 | <0.40 | |

Loadings
(lbs/day) 11.3 0.6 1.1 <0.01 <0.6 <2.26

RECEIVING WATERCOURSE: Vermilion River

* Closed in 1978.

NAME: INCO Metals Company
Victoria Mine*

LOCATION: 24 miles west of Sudbury

PRODUCTS: Nickel ore (to Clarabelle Mill)

RATED CAPACITY OF MILL: 300 tons per day

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 88,000 Igpd (minewater)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 10.7 | 8 | 0.1 | 0.2 | <0.002 | <.1 | <0.402 | |

| | | | | | | |
|-----------------------|---|-----|-----|--------|------|------|
| Loadings (lbs/day) | 7 | 0.1 | 0.2 | (neg.) | <0.1 | <.35 |
|-----------------------|---|-----|-----|--------|------|------|

RECEIVING WATERCOURSE: Vermilion River

* Closed in 1978.

NAME: INCO Metals Company
Levack/Levack West Mine/Mill

LOCATION: Onaping Falls, 30 miles NW of Sudbury

PRODUCTS: Nickel and copper concentrates

RATED CAPACITY OF MILL: 7,000 tons per day

TAILINGS DISCHARGED: 874,232 tons per year

VOLUME FINAL EFFLUENT: 1,969,000 lgpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 9.5 | 7 | 0.1 | 0.3 | <0.002 | <.1 | <0.502 | |

| | | | | | | |
|-----------------------|-----|-----|-----|-------|------|-------|
| Loadings (lbs/day) | 138 | 2.0 | 5.9 | <0.04 | <2.0 | <9.88 |
|-----------------------|-----|-----|-----|-------|------|-------|

RECEIVING WATERCOURSE: Grassy Creek/Onaping River.

NAME: INCO Metals Company
Frood-Stobie Mine/Mill

LOCATION: North Sudbury city limits

PRODUCTS: Nickel/copper bulk concentrates

RATED CAPACITY OF MILL: 22,500 tons per day

TAILINGS DISCHARGED: 3,975,442 tons per year (12,700 tpd).

VOLUME FINAL EFFLUENT: 5,739,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|

Discharged to tailings area - No readings taken

Loadings
(lbs/day) N/A

RECEIVING WATERCOURSE: P-Q tailings area/Copper Cliff Creek.

NAME: INCO Metals Company
Creighton Mine (#5, #9 shafts)

LOCATION: 9 miles W of Sudbury

PRODUCTS: Nickel ore (to Clarabelle Mill)

RATED CAPACITY OF MILL: * 12,000 tons per day

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 4,132,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|

Discharges to tailings area

| | |
|-----------------------|----------------|
| Loadings (lbs/day) | Not applicable |
|-----------------------|----------------|

RECEIVING WATERCOURSE: P-Q tailings area/Copper Cliff Creek

* Creighton mill rated at 10,500 tpd temporarily suspended.

NAME: INCO Metals Company
Garson Mine

LOCATION: 8.5 miles NE of Sudbury

PRODUCTS: Nickel Ore (to Clarabelle Mill)

RATED CAPACITY OF MILL: 4,600 tons per day

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 452,000 lpgpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|------|----|-----|-----|--------|-----|-------------|----|
| 10.6 | 7 | 0.1 | 0.8 | <0.002 | 0.1 | <1.002 | |

Loadings
(lbs/day) 32 0.5 3.6 <0.01 .5 <4.53

RECEIVING WATERCOURSE: Junction Creek

NAME: INCO Metals Company
Copper Cliff Creek Plant

LOCATION: Sudbury area

PRODUCTS: Treated effluent

RATED CAPACITY OF MILL: 60,000,000 Igpd

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 18,000,000 Igpd

(Partial by-pass during spring and
heavy precipitation periods.)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-----|----|-----|-----|--------|-------|-------------|----|
| 9.7 | 32 | 0.2 | 1.3 | <0.002 | 0.12* | <1.622 | |

Loadings
(lbs/day) 5760 36 234 <0.36 21.6 <292

RECEIVING WATERCOURSE: Kelly Lake

* Scan value

ANNUAL AVERAGE FLOW BY-PASS SUMMARY

INCO COPPER CLIFF CREEK TREATMENT PLANT

(FLOWS IN IGPD x 10³)

| | <u>Treated</u> | <u>Percent</u> | <u>By-passed</u> | <u>Percent</u> |
|--------------|----------------|----------------|------------------|-------------------|
| <u>1976</u> | | | | |
| Oct. | 26,733 | 99.9 | 27 | 0.1 |
| Nov. | 19,872 | 97.4 | 530 | 2.6 |
| Dec. | 10,860 | 99.9 | 11 | 0.1 |
| <u>1977</u> | | | | |
| Jan. | 5,585 | 100 | - | - |
| Feb. | 14,101 | 99.9 | 11 | 0.1 |
| Mar. | 28,716 | 64.0 | 16,131 | 36 - 11 days only |
| Apr. | 25,597 | 88.0 | 3,625 | 12 |
| May | 16,508 | 99.9 | 15 | 0.1 |
| June | 21,287 | 100 | - | - |
| July | 12,783 | 92.9 | 972 | 7.1 |
| Aug. | 15,449 | 99.5 | 80 | 0.5 |
| Sept. | 13,062 | 78.1 | 3,673 | 21.9 |
| Oct. | 15,440 | 73.3 | 5,616 | 26.7 |
| Nov. | 22,990 | 95.6 | 1,070 | 4.4 |
| Dec. | 17,867 | 99.3 | 127 | 0.7 |
| 1977 Average | 17,532 | 87.0 | 2,610 | 13.0 |

NAME: INCO Metals Company
Nolin Creek Plant

LOCATION: Sudbury area

PRODUCTS: Treated effluent

RATED CAPACITY OF MILL: 6,331,000 Igpd

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 1,900,000 Igpd

(partial by-pass during spring and heavy precipitation periods).

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-----|----|------|-----|--------|-----|-------------|----|
| 9.1 | 33 | <0.8 | 3.0 | <0.002 | <.2 | <4.002 | |

| | | | | | | |
|-----------------------|-----|------|----|-------|------|--------|
| Loadings (lbs/day) | 627 | 15.2 | 57 | <0.04 | <3.8 | <76.04 |
|-----------------------|-----|------|----|-------|------|--------|

RECEIVING WATERCOURSE: Nolin Creek

ANNUAL AVERAGE FLOW BY-PASS SUMMARY

INCO NOLIN CREEK TREATMENT PLANT

(FLOWS IN IGPD x 10³)

| | <u>Treated</u> | <u>Percent</u> | <u>By-passed</u> | <u>Percent</u> |
|---------------|----------------|----------------|------------------|----------------|
| <u>1976</u> | | | | |
| Oct. | 2,355 | 97 | 73 | 3 |
| Nov. | 1,260 | 100 | - | 0 |
| Dec. | 991 | 100 | - | 0 |
| <u>1977</u> | | | | |
| Jan. | 972 | 100 | - | 0 |
| Feb. | 851 | 100 | - | 0 |
| Mar. | 2,641 | 21.8 | 9,464 (11 days) | 79.2 |
| Apr. | 2,823 | 59.3 | 1,934 | 40.7 |
| May | 1,068 | 100 | - | 0 |
| June | 667 | 100 | - | 0 |
| July | 1,376 | 81.3 | 316 | 18.7 |
| Aug. | 1,966 | 82.6 | 415 | 17.4 |
| Sept. | 2,084 | 39.4 | 3,212 | 60.6 |
| Oct. | 2,684 | 66.1 | 1,378 | 33.9 |
| Nov. | 2,654 | 76.0 | 836 | 24.0 |
| Dec. | 2,589 | 95.7 | 116 | 4.3 |
| 1977 Averages | 1,865 | 55.9 | 1,473 | 44.1 |

IRON MINING OPERATIONS

OXIDE: CARBONATE

NAME: Cliffs of Canada Limited
The Sherman Mine

LOCATION: 60 miles N of North Bay - near Temagami

PRODUCTS: Iron oxide pellets

RATED CAPACITY OF MILL: 3,260 tpd pellets
11,000 tpd iron ore

TAILINGS DISCHARGED: 3,000,000 tons per year

VOLUME FINAL EFFLUENT: 1,200,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-----|-----|------|-----|------|------|-------------|-------|
| 7.6 | 4.5 | <0.1 | 0.1 | <0.1 | <0.1 | <0.4 | <0.01 |

| | | | | | | | |
|-----------------------|----|------|-----|------|------|------|-------|
| Loadings (lbs/day) | 54 | <1.2 | 1.2 | <1.2 | <1.2 | <4.8 | <0.12 |
|-----------------------|----|------|-----|------|------|------|-------|

RECEIVING WATERCOURSE: O'Conner Lake/Tetapaga River

NAME: Dominion Foundries and Steel Co. Ltd.
Adams Mine

LOCATION: 8 miles SE of Kirkland Lake

PRODUCTS: Iron oxide pellets

RATED CAPACITY OF MILL: 3,300 tons per day (pellets)
10,000 tons per day (iron ore)

TAILINGS DISCHARGED: 2,300,000 tons per year

VOLUME FINAL EFFLUENT: 2,600,000 lgpds

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>Fe</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.1 | 4 | <0.01 | 0.1 | <0.1 | <0.1 | <0.31 | <0.01 |

| | | | | | | | |
|-----------------------|-----|-------|-----|------|------|-------|-------|
| Loadings (lbs/day) | 104 | <0.26 | 2.6 | <2.6 | <2.6 | <8.06 | <0.25 |
|-----------------------|-----|-------|-----|------|------|-------|-------|

RECEIVING WATERCOURSE: Misema River

NAME: National Steel Corp.
Moose Mountain Mine

LOCATION: Sellwood, 16 miles NW of Capreol

PRODUCTS: Iron oxide pellets

RATED CAPACITY OF MILL: 4,000 tons per day

TAILINGS DISCHARGED: 900,000 tons per year

VOLUME FINAL EFFLUENT: Nil - high volume recycle

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-------------------------------|----------------------------|-----------|-----------|-----------|-----------|--------------------|-----------|
| | | | | | | Not applicable | |
| Loadings (lbs/day) | | | | | | Not applicable | |
| <u>RECEIVING WATERCOURSE:</u> | Vermilion River (seepages) | | | | | | |

NAME: Algoma Steel Corp.
McLeod Mine, Wawa

LOCATION: 140 miles N of Sault Ste. Marie

PRODUCTS: Iron oxide sinter

RATED CAPACITY OF MILL: 6,000 tons per day (sinter)
8,800 tons per day (prepared ore)

TAILINGS DISCHARGED: 130,400 tons per year

VOLUME FINAL EFFLUENT: 4,560,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| | pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-----------------------|------|------|-------|-------|-------|------|-------------|----|
| March 29/77 | 7.7 | <15 | 0.09 | <0.01 | <0.01 | 0.18 | <0.29 | |
| Loadings (lbs/day) | <684 | 4.10 | <0.46 | <0.46 | 8.21 | | <13.22 | |

RECEIVING WATERCOURSE: Magpie River

NAME:

Marmoraton Mining Company Ltd.

(to be taken over June 1978 by
Ambrose Sand and Gravel)LOCATION:

1 mile E of the Village of Marmora

PRODUCTS:3,000 tons/day (iron oxide concentrates)
1,500 tons/day (iron oxide pellets)TAILINGS DISCHARGED: 460,000 tons per yearVOLUME FINAL EFFLUENT: 445,000 gallons per dayCHEMICAL CHARACTERISTICS OF DISCHARGE:

| | <u>ppm</u> | <u>lbs/day</u> |
|------------------|------------|----------------|
| pH | 7.3 | - |
| Suspended Solids | 7 | 31 |
| Copper as Cu | .02 | .09 |
| Nickel as Ni | <.01 | <.04 |
| Lead as Pb | <.01 | <.04 |
| Zinc as Zn | - | - |
| Cu+Ni+Pb+Zn | <.04 | <.18 |

RECEIVING WATERCOURSE: Mud Lake: Lily Creek: Moira RiverCOMMENTS: This property is expected to terminate operations in March 1978. The mine may be maintained on standby for two years. During this period, pit water could be discharged from the property presumably via Lily Creek.

NAME: Steep Rock Iron Mines

LOCATION: Atikokan, Steep Rock Lake
100 miles W of Thunder Bay

PRODUCTS: Iron oxide pellets

RATED CAPACITY OF MILL: Concentrator: 5,000 tpd crude ore
Pellet Plant: 4,240 tpd, iron oxide pellets

TAILINGS DISCHARGED: (5,600,000 Igpd) to reclaim basin
6 months per year

VOLUME FINAL EFFLUENT: 2 weeks/yr. - 1,000,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|--------------------------------------------------------------|----|-----|----|----|----|-------------|----|
| Total recycle - negligible overflow | | | | | | | |
| Mine water sampling being set up jointly with Caland Ore. | | | | | | | |
| Loadings (lbs/day) | | N/A | | | | | |

RECEIVING WATERCOURSE: Reclaim basins
A-2 shaft mine water to Long Paradise Lake

NAME: Caland Ore Co. Ltd.
Falls Bay Mine

LOCATION: Atikokan, Steeprock Lake, NW Ont.

PRODUCTS: Iron oxide pellets

RATED CAPACITY OF MILL: 3,400 tons per day (pellets)

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 633,600 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-------|----|----|----------------------------|----|----|-------------|----|
| <15.0 | | | Not measured. | | | | |
| | | | Program being established. | | | | |

Loadings
(lbs/day) <95 Not available

RECEIVING WATERCOURSE: Icy Lake/Marmion Lake

NAME: Pickands Mather & Co., Managing Agent
The Griffith Mine

LOCATION: 32 miles south of Red Lake

PRODUCTS: Iron Oxide Pellets

RATED CAPACITY OF MILL: 15,000 tons per day

TAILINGS DISCHARGED: 3,200,000 tons per year

VOLUME FINAL EFFLUENT: 8,520,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.9 | 15 | 0.03 | <0.02 | <0.03 | 0.03 | <0.11 | |

| | | | | | | |
|-----------------------|------|------|-------|-------|------|-------|
| Loadings (lbs/day) | 1278 | 2.56 | <1.70 | <2.56 | 2.56 | <9.37 |
|-----------------------|------|------|-------|-------|------|-------|

RECEIVING WATERCOURSE: Troutlake River/Pakwash Lake

NOTE: In late fall of 1977, company eliminated discharge of tailings and excess water to the emergency tailings area. As a result, a drop in suspended solids concentration is expected in 1978.

URANIUM

MINING

OPERATIONS

NAME: Denison Mines Ltd.
Elliot Lake

LOCATION: West shore Quirke Lake

PRODUCTS: Yellow Cake (Ammonium Diuranate)

RATED CAPACITY OF MILL: 7,100 tons per day

TAILINGS DISCHARGED: 2,000,000 tons per year

VOLUME FINAL EFFLUENT: 4,400,000 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | Ra ²²⁶ |
|-----|-----|------|------|------|------|-------------|-------------------|
| 8.0 | <10 | 0.01 | 0.01 | 0.01 | 0.01 | 0.04 | 2.5 (pci/l) |

Loadings
(lbs/day) <440 0.44 0.44 0.44 0.44 1.76

RECEIVING WATERCOURSE: Serpent River

April 5, 1978

NAME: Rio Algom Ltd.
Quirke Mine/Mill

LOCATION: Elliot Lake

PRODUCTS: Yellow cake (ammonium diuranate)

RATED CAPACITY OF MILL: 4,500 tons per day (expanding to 7,000 by 1978)

TAILINGS DISCHARGED: 1,500,000 tons per year

VOLUME FINAL EFFLUENT: 5,400,000 l gpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>Ra226</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|----------------|
| 7.5 | <15 | 0.02 | 0.04 | .07 | 0.02 | 0.15 | 7.5 (pci/l) |

Loadings
(lbs/day) <810 1.08 2.16 3.78 1.08 8.1

RECEIVING WATERCOURSE: Serpent River

NAME: Agnew Lake Mines Ltd.
Twp. Hyman

LOCATION: 30 miles W of Sudbury

PRODUCTS: Yellow Cake (ammonium diuranate)

RATED CAPACITY OF MILL: 1,000,000 lbs/year U₃O₈

TAILINGS DISCHARGED: Varies (unknown)

VOLUME FINAL EFFLUENT: N/A

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|

New tailings pond being filled, discharge
expected fall of 1978

Loadings
(lbs/day)

RECEIVING WATERCOURSE: Ministic Creek (proposed)

NAME: Madawaska Mines Ltd.

LOCATION: Bancroft, Faraday Twp.

PRODUCTS: Yellow Cake (Sodium Magnesium Diuranate)

RATED CAPACITY OF MILL: 1,176 tons per day
2,217 lbs/day yellow cake

TAILINGS DISCHARGED: 279,093 tpy to tailings
15,975 tpy to backfill

VOLUME FINAL EFFLUENT: 309,600 Igpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | Ra226 |
|-----|-----|------|------|-------|------|-------------|----------------|
| 6.8 | <15 | 0.02 | 0.04 | <0.03 | 0.03 | <0.12 | 3.7 (pci/l) |

Loadings
(lbs/day) <46 0.06 0.12 <0.09 0.09 <0.37

RECEIVING WATERCOURSE: Bow Lake/Crowe River

INDUSTRIAL MINERAL OPERATIONS

TALC
FIBRE
NEPHELINE SYENITE
BASALT/ROOF CHIPS
GYPSUM
SALT
MAGNESIUM CARBONATE

NAME: Canada Talc Industries Ltd.

LOCATION: Madoc

PRODUCTS: Talc, Dolomite, Terrazo chips

RATED CAPACITY OF MILL: 45 - 125 tons per day

TAILINGS DISCHARGED: 300 tons per month - mine waste

VOLUME FINAL EFFLUENT: 216,000 Igpd - mine water

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| | | | | | | N/A | |

Loadings
(lbs/day) N/A

RECEIVING WATERCOURSE: Moira Lake

NAME: Hedman Mines Ltd.
Timmins, Ontario

LOCATION (Plant) Matheson, Ontario

PRODUCTS: Hedman Cationic Fibre
(predominantly lizardite)

RATED CAPACITY OF MILL: 600 tons per day

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: Nil - essentially dry operation

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| | | | N/A | | | | |

Loadings
(lbs/day) N/A

RECEIVING WATERCOURSE: N/A

NAME: International Minerals & Chemical
Corp. (Canada) Ltd.
Ceramics and Glass Division

LOCATION: Blue Mountain, Havelock, NE Peterborough

PRODUCTS: Nepheline Syenite

RATED CAPACITY OF MILL: 800 tons per day

TAILINGS DISCHARGED: 200 tons per day

VOLUME FINAL EFFLUENT: Intermittent - emergency tailings
system used. (250,000 Igpd)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|-------|----|----|----|----|----|-------------|----|
| 7 - 8 | 15 | | | | | <1.0 | |

Loadings
(lbs/day) 37.5 (intermittent) <2.5

RECEIVING WATERCOURSE: swamp

NAME: Indusmin Ltd.

LOCATION: Nephton, NE Peterborough

PRODUCTS: Nepheline Syenite

RATED CAPACITY OF MILL: 1,500 tons per day

TAILINGS DISCHARGED: 87,500 tons per year

VOLUME FINAL EFFLUENT: 400,000 l gpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 8.5 | 20 | | | | | <1.00 | |

Loadings
(lbs/day) 80 <4

RECEIVING WATERCOURSE: Jack's Creek/Stoney Lake

NAME: 3M Company

LOCATION: Havelock

PRODUCTS: Basalt/Roof chips

RATED CAPACITY OF MILL: 1,500 tons per day

TAILINGS DISCHARGED: 700 tons per day

VOLUME FINAL EFFLUENT: 10,000 Igpd (approx.)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | <u>Cu+Ni+Pb+Zn</u> | As |
|-----|----|----|----|----|----|--------------------|----|
| 8.0 | 20 | | | | | <1.0 | |

| | | |
|-----------------------|---|-----|
| Loadings (lbs/day) | 2 | <.1 |
|-----------------------|---|-----|

RECEIVING WATERCOURSE: Plato Creek

NAME: Canadian Gypsum Co. Ltd.

LOCATION: 3 miles north of Hagersville

PRODUCTS: Gypsum plasters and wallboards

RATED CAPACITY OF MILL: 325,000 tons per year

TAILINGS DISCHARGED: 50,000 - 70,000 tons per year (utilized)

VOLUME FINAL EFFLUENT: (30,000 Ig/hr)

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>TDS</u> | <u>SO₄</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>Ni</u> |
|-----------|-----------|------------|-----------------------|-----------|-----------|--------------------|-----------|
| 7.7 | 7 | 2817 | 1520 | <0.02 | <0.01 | <1.0 | <0.01 |

Loadings
(lbs/day) N/A

RECEIVING WATERCOURSE: Boston Creek/Grand River

NAME: Domtar Construction Materials Ltd.

LOCATION: Caledonia

PRODUCTS: Gypsum, wallboard

RATED CAPACITY OF MILL: 2,100 tpd
200 tpd plaster finish goods
850,000 sq. ft/day board products
47,600 tons/year plaster
190,000,000 sq.ft/yr board.

VOLUME FINAL EFFLUENT: Essentially a dry operation.
Mine water not available.

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|--------------|----|----|----|----|----|-------------|----|
| | | | | | | | |
| Not measured | | | | | | | |

Loadings
(lbs/day) N/A

RECEIVING WATERCOURSE: Barton Creek/Grand River

NAME: Domtar Chemicals Ltd.
Sifto Salt Division

LOCATION: Goderich Harbour, mouth of Maitland River

PRODUCTS: 1) Common salt
2) Rock salt

RATED CAPACITY OF MILL: 1) 270 tons per day Common Salt
2) 9,600 tons per day (screening rate)

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 1) 2,900,000 Igpd (from evaporators, etc.)
2) Nil

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| pH | SS | Cu | Ni | Pb | Zn | Cu+Ni+Pb+Zn | As |
|---------|----|-----------------------------|----|----|----|-------------|----|
| (1) 8.0 | 15 | (Not measured - negligible) | | | | <1.0 | |

Loadings
(lbs/day) 435 <29

RECEIVING WATERCOURSE: Maitland River

NAME: The Canadian Rock Salt Co. Ltd.
Ojibway Mine

LOCATION: Windsor, Ont.

PRODUCTS: Rock salt products

RATED CAPACITY OF MILL: 12,000 tpd

TAILINGS DISCHARGED: nil

VOLUME FINAL EFFLUENT: Nil

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

pH SS Cu Ni Pb Zn Cu+Ni+Pb+Zn As

Loadings (lbs/day)

RECEIVING WATERCOURSE: Dry operation

NAME: The Canadian Salt Co. Ltd.,
30 Prospect Ave.

LOCATION: Windsor, Ontario

PRODUCTS: Salt

RATED CAPACITY OF MILL: 550 tpd refined common salt.
600,000 gals/day brine from salt wells.

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 3,800,000 l/gpd

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 8.2 | 16 | | | | | <1.00 | |

Loadings
(lbs/day) 608 <38

RECEIVING WATERCOURSE: Detroit River

NAME: Chromasco Corp. Ltd.

LOCATION: Haley, 12 miles NE of Renfrew

PRODUCTS: Magnesium, Calcium

RATED CAPACITY OF MILL: (currently expanding)

TAILINGS DISCHARGED: Nil

VOLUME FINAL EFFLUENT: 20,000 Igpd (max.) - intermittent

AVERAGE CHEMICAL CHARACTERISTICS
OF DISCHARGE (PPM)

| <u>pH</u> | <u>SS</u> | <u>Cu</u> | <u>Ni</u> | <u>Pb</u> | <u>Zn</u> | <u>Cu+Ni+Pb+Zn</u> | <u>As</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----------|
| 7.8 | 419 | 0.10 | 0.01 | 0.07 | 0.21 | 0.39 | |

| | | | | | | |
|-----------------------|----|------|------|------|------|------|
| Loadings (lbs/day) | 84 | 0.02 | 0.00 | 0.01 | 0.04 | 0.08 |
|-----------------------|----|------|------|------|------|------|

RECEIVING WATERCOURSE: Ottawa River via Un-named Creek

APPENDIX B

ESTIMATION OF
DECANT WATER
RECYCLED IN ONTARIO

ESTIMATION OF DECANT WATER RECYCLED IN ONTARIO

Feb. 13/78

| <u>Operation</u> | <u>(Igpd)</u> |
|--------------------------------------------|--------------------|
| 1. Falconbridge Nickel Mines, Falconbridge | 500,000 * |
| 2. Falconbridge Nickel Mines, Strathcona | 3,500,000 |
| 3. Inco Metals Company | 26,000,000 |
| 4. Texasgulf (90%) | 8,000,000 |
| 5. Mattabi (60 - 70%) | 1,440,000 |
| 6. Noranda Geco | 2,330,000 |
| 7. Steeprock Iron | 5,600,000 |
| 8. Stelco, Griffith (82%) | 39,569,000 |
| 9. Sherman (875 USGPM) | 1,049,200 |
| 10. Adams (50%) | 2,100,000 |
| 11. National Steel Corp. (97%) | 20,000,000 |
| 12. Falconbridge Copper (65%) | 748,800 |
| 13. Canadaka Mines Ltd. | 245,000 |
| 14. Inco, Shebandowan | <u>496,800</u> |
| TOTAL: | <u>111,578,800</u> |

* will change after start-up of new smelter

TD
428
M57
W38
1978